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ENR 381

$$1) \frac{d^2y}{d\theta^2} + 4\frac{dy}{d\theta} + 5y = 6\sin\theta$$

Convert into a homogeneous equation.

$$\frac{d^2y}{d\theta^2} + 4\frac{dy}{d\theta} + 5y = 0$$

$$m^2 + 4m + 5 = 0$$

$$a=1, b=4, c=5$$

$$m = \frac{-4 \pm \sqrt{4^2 - 4 \times 1 \times 5}}{2 \times 1} \Rightarrow m = \frac{-4 \pm \sqrt{4}}{2}$$

$$m = \frac{-4 \pm 2j}{2}$$

$$m = -2 \pm j$$

$$CF: y = e^{-2\theta} (A \cos\theta + B \sin\theta)$$

$$y = C \cos\theta + D \sin\theta$$

$$\frac{dy}{d\theta} = -(\sin\theta + D \cos\theta)$$

$$-(\cos\theta - D \sin\theta) + [-\sin\theta + D \cos\theta] + 5[C \cos\theta + D \sin\theta] = 6 \sin\theta$$

$$-(\cos\theta - D \sin\theta) - 4(\sin\theta + D \cos\theta) + 5(C \cos\theta + D \sin\theta) = 6 \sin\theta$$

$$-(+4D) + 5C = 0$$

$$-D + 4C + 5D = 6$$

$$+ 4C + 4D = 0 \quad \text{--- (1)}$$

$$4C + 4D = 6 \quad \text{--- (2)}$$

$$8D = 6$$

$$D = \frac{6}{8} = \frac{3}{4}$$

Substitute $D = \frac{3}{4}$ in eqn (1)

$$-4C + 4\left(\frac{3}{4}\right) = 6$$

$$-4C + 3 = 6$$

$$-4C = 3$$

$$C = -\frac{3}{4}$$

$$y = \frac{3}{4} (\cos \theta + \frac{3}{4} \sin \theta)$$

$$y = e^{-2\theta} (A \cos \theta + B \sin \theta) - \frac{3}{4} \sin \theta$$

$$y = e^{-2\theta} (A \cos \theta + B \sin \theta) + \frac{3}{4} (\sin \theta - \cos \theta)$$

at steady state.

$$\frac{dy}{d\theta} = 0 \quad \text{and } \theta = \alpha$$

$$y = e^{-2\alpha} (A \cos \alpha + B \sin \alpha) + \frac{3}{4} (\sin \alpha - \cos \alpha)$$

$$\frac{dy}{d\theta} = (B \cos \theta - A \sin \theta) - 2e^{-2\theta} (A \cos \theta + B \sin \theta) + \frac{3}{4} (\sin \theta - \cos \theta)$$

$$\frac{dy}{d\theta} = e^{-2\alpha} (B \cos \alpha - A \sin \alpha) - 2e^{-2\alpha} (A \cos \alpha + B \sin \alpha) + \frac{3}{4} (\sin \alpha - \cos \alpha)$$

$$\frac{dy}{d\theta} = \frac{3}{4} (\sin \alpha - \cos \alpha)$$

$$\frac{dy}{d\theta} = \frac{3}{4} (\sin \alpha - \cos \alpha)$$

$$\textcircled{2} \text{EI} \frac{d^2 y}{dx^2} = \frac{w}{2} (L-x)^2$$

$$\text{EI} \frac{dy}{dx} = 0$$

$$\text{EI} m^2 = 0$$

$$m^2 = 0 \Rightarrow m = \pm \sqrt{0} = 0$$

$$m_1 = m_2 = 0$$

$$y = e^{0x} (A + Bx)$$

$$\text{CF} \therefore y = A + Bx$$

$$y = Rx^2 + Sx^3 + Tx^4$$

$$\frac{dy}{dx} = 2Rx + 3Sx^2 + 4Tx^3$$

$$\frac{d^2 y}{dx^2} = 2R + 6Sx + 12Tx^2$$

$$\text{EI} [2R + 6Sx + 12Tx^2] = \frac{w}{2} (L-x)^2$$

$$2R \text{EI} + 6Sx \text{EI} + 12Tx^2 \text{EI} = \frac{w}{2} [L^2 - 2Lx + x^2]$$

$$4R \text{EI} + 12Sx \text{EI} + 24Tx^2 \text{EI} = wL^2 - 2wLx + wx^2$$

$$24T \text{EI} = w$$

$$T = \frac{w}{24 \text{EI}}$$

$$R \delta I = -2 \omega l$$

$$S = \frac{-2 \omega l}{24 EI}$$

$$y = \left[\frac{\omega l^2}{-4 EI} \right] x^2 - \left[\frac{\omega l}{6 EI} \right] x^3 + \left[\frac{\omega}{24 EI} \right] x^4$$

$$y = \frac{\omega l^2 x^2}{4 EI} - \frac{\omega l x^3}{6 EI} + \frac{\omega x^4}{24 EI}$$

$$y = \frac{6 \omega l^2 x^2 - 4 \omega l x^3 + \omega x^4}{24 EI}$$

$$y = \frac{6 \omega l^2 x^2 - 4 \omega l x^3 + \omega x^4}{24 EI}$$

$$P1 \div y = \frac{\omega}{24 EI} [6l^2 x^2 - 4lx^3 + x^4]$$

$$y = A + Bx + \frac{\omega}{24 EI} [6l^2 x^2 - 4lx^3 + x^4]$$

$$\text{at } x=0 ; y=0 ; \frac{dy}{dx} = 0$$
$$0 = A + B(0) + \frac{\omega}{24 EI} [12l^2(0) - 12l(0)^2 + 4(0)^3]$$

$$B = 0$$

When $A = B = 0$

$$y = 0 + 0x + \frac{\omega}{24 EI} [6l^2 x^2 - 4lx^3 + x^4]$$

$$y = \frac{\omega}{24 EI} [6l^2 x^2 - 4lx^3 + x^4]$$

When $x=l$

$$y = \frac{\omega}{24 EI} [6l^4 - 4l^4 + l^4]$$

$$y = \frac{\omega}{24 EI} [3l^4]$$

$$y = \frac{\omega l^4}{8 EI}$$

